TITLE OF THE INVENTION

MULTIBLADE BLOWER

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a multiblade blower installed in an air conditioning system for a vehicle, and the like.

DESCRIPTION OF THE RELATED ART

A multiblade blower includes an impeller having a plurality of blades placed circumferentially around a rotation shaft, and when the impeller is rotated, air is taken in from a side of an inner diameter end portion of the blade, and is discharged from a side of an outer diameter end portion thereof. A blower performance such as air blowing ability and noise of the multiblade blower is influenced by the shapes of the blades and the shape of a casing for housing the impeller, and the like. Since the length in an air flowing direction of each of the blades is short in the multiblade blower, an air flow flowing along the blade is difficult to form, and a vortex flow occurs due to separation of the air flow. This vortex flow reduces the air blowing ability, and is a main cause of the noise.

In order to solve the above problems, the applicant filed the application of the multiblade blower shown in FIG. 5 and FIG. 6 (Japanese Patent Application No. 2001-384139). FIG. 5 shows an impeller 1 of the multiblade blower, and FIG. 6 shows blades 2 section encircled by the alternate long and short dash line in FIG. 5.

The impeller 1 includes a number of blades 2 circumferentially with a central rotation shaft as its center as shown in FIG. 5, and when the blades 2 rotate around the rotation shaft, air is taken in

from sides of inner diameter end portions 2a of the blades 2 and is discharged from sides of outer diameter end portions 2b.

Here, the blade 2 is in a wing shape at the side of the inner diameter end portion 2a (a front half part of the blade 2). Namely, it is in a shape in which the thickness of the blade gradually increases once, and thereafter, gradually decreases. The shape of the front half part of the blade 2 restrains disturbance of an air flow. The thickness of the blade 2 at the side of the outer diameter end portion 2b (a rear half part of the blade 2) is substantially uniform and linear. Due to this, the separation of air at the rear half part of the blade 2 is restrained, and occurrence of a vortex flow at the wake flow behind the blade 2 is restrained.

However, in the multiblade blower described in the aforementioned application, the outer diameter end portion 2b of each of the adjacent blades 2 is placed to be somewhat spaced from each other, and therefore as shown in FIG. 6, there arises the possibility that air flowing to a suction surface of the outer diameter end portion 2b is deviated to a pressure surface of the other adjacent blade 2 to form a shearing flow 3 behind the blade 2.

In order to solve the above-described problems, a method for forcefully restraining a deviating flow of air by forming a space between the outer diameter end portions 2b of the adjacent blades 2 to be small can be considered.

However, pressure recovery becomes insufficient by the increase in relative velocity of air flowing between the outer diameter end portions 2b, and there is the possibility that air blowing performance and noise property are reduced at operating points with high pressure loss.

SUMMARY OF THE INVENTION

In consideration of the problems of the aforementioned prior art, an object of the present invention is to provide a multiblade blower capable of improving air blowing performance and reducing noise by placing a plurality of kinds of blades outside and inside.

In order to solve the aforementioned problems, the present invention is a multiblade blower including an impeller having a plurality of blades placed circumferentially, and taking in air from a side of an inner diameter end portion of each of the blades and discharging the air from a side of an outer diameter end portion of each of the blades by rotation of the impeller, and has a structure in which two or more of blade groups in each of which said blades are placed in a ring shape are placed at least in a diameter direction inside and outside, and each blade of the outer blade group out of the blade groups is placed inside an air flow passing between blades of the inner blade group.

Air flows along pressure surfaces and suction surfaces of the inner blade group by rotation of the impeller. When air passing through the inner blade group, air flowing along the suction surfaces of the blades tends to separate from the suction surfaces, and shearing flows tend to be formed behind the outer diameter end portions of the blades.

Concerning this, the blades of the outer blade group according to the present invention are placed inside air flows passing between the blades of the inner blade group, and therefore the blades of the outer blade group can change the flows of the air so as to avoid separation of the air flow, and the shearing flows.

The aforementioned object and the other objects, the characteristics, and the advantages of the present invention will be made apparent by the following explanation and the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional view of an air conditioning system for a vehicle;

FIG. 2 is a front view of an impeller of a multiblade blower according to the present invention;

FIG. 3 is a partial sectional side view of the impeller of the multiblade blower according to the present invention;

FIG. 4 is a sectional view showing air flows at main blades and auxiliary blades according to the present invention;

FIG. 5 is a front view of an impeller of a conventional multiblade blower; and

FIG. 6 is a sectional view showing air flows at a blades section of the conventional multiblade blower.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 to FIG. 4 show an embodiment of a multiblade blower according to the present invention.

On explaining the multiblade blower according to the present invention, an outline of an air conditioning system for a vehicle loaded with the multiblade blower will be explained first with reference to FIG. 1.

An air conditioning system 10 for a vehicle has an air conditioning duct 20 for guiding a conditioning air. From an upwind side to a leeward side in the air conditioning duct 20, a multiblade blower 30, an evaporator 40 being a component of a refrigeration circuit, and a heater core 50, to which warm water is supplied from a radiator, are placed in order. An outside air intake port 60a and an inside air intake port 60b are provided at the upwind side of the air conditioning duct 20. An upward air outlet port 60c for defrosting, an upper air outlet port

60d for blowing air toward a chest of a passenger, and a foot air blowing port 60e for blowing air to feet of the passenger are provided at a leeward side of the air conditioning duct 20. The ports 60a to 60e are controlled by dampers 70a to 70d. Further, a ventilation amount to the heater core 50 is controlled by an air mix damper 70e.

When an inside of a cabin is cooled, the multiblade blower 30 is driven. Due to this, inside air or outside air passes through the evaporator 40 in which a refrigerant flows. The air passing through the evaporator 40 is cooled by the evaporator 40, and cold air is generated. The cold air is blown into the cabin through at least one of the outlet ports 60c to 60e to cool the inside of the cabin. On the other hand, the multiblade blower 30 is also driven when the inside the cabin is heated. Due to this, the inside air or the outside air passes through the heater core 50 in which a warm water flows. The air passing through the heater core 50 is heated by the heater core 50, and warm air is generated. The warm air is blown into the cabin through at least one of the outlet ports 60c to 60e, and the inside of the cabin is warmed. It should be noted that the outlined arrows in FIG. 1 show the flow of the air.

Incidentally, the air conditioning duct 20 for an automobile cannot be made large from the relationship with the vehicle body, and following this, the multiblade blower 30 cannot help becoming compact, but in order to air-condition the inside of the cabin reliably even with the compact blower, the multiblade blower with high air blowing performance is demanded. In addition, the one with less noise is demanded to keep the inside of the cabin quiet.

In order to meet the above demands, the multiblade blower 30 according to the present embodiment adopts the following structure.

The multiblade blower 30 has an impeller 32 housed in a scroll

31 as shown in FIG. 1. The impeller 32 is driven by an electric motor 33. The impeller 32 is integrally formed of a resin. The impeller 32 has a drive plate 34 expanded toward an air intake side, and a rotation shaft (not shown) of an electric motor 33 is connected to a boss part 35 at a center of the drive plate 34, as shown in FIG. 2 and FIG. 3. Two kinds of blade groups 37 and 38 are fixed between an edge of the drive plate 34 and a connecting ring 36 of an edge of an air intake side. The blade groups 37 and 38 are placed inside and outside with the rotation shaft as a center. The inner blade group 37 is constructed by large main blades 371 for taking in the inside and outside air. The outer blade group 38 is constructed by small auxiliary blades 381 for changing the flow of air taken in by the main blades 371.

The main blade 371 and the auxiliary blade 381 are in a wing shape which once gradually increases and thereafter gradually decreases in the blade thickness as shown in FIG. 4. The main blade 371 is larger than the auxiliary blade 381 in the blade thickness, and warping of the main blade 371 is larger than the auxiliary blade 381. The main blade 371 is larger than the auxiliary blade 381 in chord length, whereby the intake ability of the main blade 371 is higher than the intake ability of the auxiliary blade 381.

The main blades 371 and the auxiliary blades 381 constructed as above are placed as shown in FIG. 4. Namely, each of the auxiliary blades 381 is placed inside the air flow passing between the adjacent main blades 371.

Describing this in detail, as shown in FIG. 4, an inner diameter end portion 381a of each of the auxiliary blade 381 is placed between a pressure surface 371c of an outer diameter end portion 371b of one of the adjacent main blades 371 and a suction surface 371d of the other main blade 371, and an outer diameter end portion 381b is extended

rearward. A space L1 between the inner diameter end portion 381a of each of the auxiliary blades 381 and the pressure surface 371c of one of the main blade 371 is smaller than a space L2 between the inner diameter end portion 381a of each of the auxiliary blades 381 and the suction surface 371d of the other main blade 371.

When the multiblade blower 30 is driven, air is taken in from the side of the inner diameter end portion 371a of the main blade 371, and the air flows along the pressure surface 371c and the suction surface 371d of the main blade 371. When the air flows between the adjacent main blades 371, the air flowing along the suction surface 371d of the main blade 371 generally tends to separate from the suction surface 371d, and a shearing flow tends to be formed behind the outer diameter end portion 371b of the main blade 371.

On the other hand, in the present embodiment, the inner diameter end portion 381a of the auxiliary blade 381 is placed between the pressure surface 371c of the outer diameter end portion 371b of one of the adjacent main blades 371 and the suction surface 371d of the other main blade 371 as described above, and therefore the auxiliary blade 381 can change the flow of air so as to avoid separation of the air flow, and the shearing flow.

In the present embodiment, the space L1 between the inner diameter end portion 381a of each of the auxiliary blades 381 and the pressure surface 371c of one of the main blades 371 is made smaller than the space L2 between the inner diameter end portion 381a and the suction surface 371d of the other main blade 371. As a result, part of the air flowing to the pressure surface 371c of the one of the adjacent main blade 371 is guided along the pressure surface 381c of the auxiliary blade 381 toward the suction surface 371d of the other of the main blades 371. Accordingly, separation of the air flow at the suction surface

371d of the main blade 371 and the shearing flow behind the main blade 371 are further restrained.

Since the separation of the air flow and the shearing flow are restrained in the multiblade blower 30 according to the present embodiment as described above, occurrence of a vortex flow is restrained, and air blowing performance and noise property are improved.

The aforementioned embodiment is constructed by the two kinds of blade groups that are the inner blade group 37 and the outer blade group 38, but three kinds or more of blade groups may be placed inside and outside to improve the air blowing performance and noise property. In the aforementioned embodiment, the auxiliary blade 381 is placed between the main blades 371, but it may be placed behind the main blade 371 depending on the wing shape of the main blade 371. Further, in the aforementioned embodiment, both of the main blade 371 and the auxiliary blade 381 are in the wing shapes, but the blade or the blades formed to have substantially uniform thickness may be adopted for one or both of them.